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Indian Standard

(Reaffirmed 1999)

STEEL HEADFRAMES FOR MINES

PART 1 PRINCIPLES OF LOAD COMPUTATION AND APPLICABLE FACTORS OF SAFETY

1. Scope — Lays down the principles of load computation and applicable factors of safety for steel headframes for mines used under normal and special operating conditions.

1.1 This standard is not applicable to winding towers where winding engine is installed on top of the headframe structure.

2. Types of Headframes — Based on functional requirements, headframes may be grouped in three types:

a) *Type A* — Headframes for installations normally used for men/mineral/material winding.

b) *Type B* — Headframes for such winding installations where winding speed does not exceed 2 m/s or for such winding installations which are not normally used for mineral/material winding and are occasionally used for men winding for the purpose of inspection and maintenance, and the winding speed does not exceed 4 m/s.

c) *Type C* — Headframes used for shaft sinking operations.

3. Assumptions of Loads

3.1 All loads to be considered in relation to headframes shall be treated as static loads. For dynamic effects certain multiplying factors shall be used depending on the specific case. For the purpose of headframe design, the working load on the rope and the rope breaking load shall be as defined in **3.1.1** and **3.1.2**.

3.1.1 *Working load of the rope* — It is the static load on the rope in the worst situation increased by ten percent for starting resistance and acceleration/retardation.

3.1.1.1 The static load shall include maximum possible load due to self-weight of suspension gear, cage or other conveyance or counter-weight, payload, weight of mine cars/mine tubs, suspension gear for balance rope and weight of balance rope.

3.1.2 *Rope breaking load* — It is the breaking load of the rope according to manufacturers recommendations and increased by five percent.

3.2 Analysis of a structure for working load shall be made only in cases where it has been stipulated that analysis for the rope breaking load for the structure is not needed.

3.3 While analyzing a structure under working load, all other loads acting on the frame like wind load, live load, etc, shall be taken into account taking the most unfavourable situations.

3.4 While analyzing a structure under exceptional cases like rope breaking conditions, only one exceptional case shall be considered at a time. For example, in case of headframes serving more than one winding rope, breaking situation shall be considered in any one rope or ropes attached to a single conveyance. Similarly, when rope breaking loads are considered, wind loads shall not be considered simultaneously.

3.5 On platforms and stairways a live load of 2 kPa shall be assumed for general maintenance. For heavy maintenance involving replacement of components for normal mining operations, higher loads may be considered. These loads shall not be taken into account for the design of the complete frame but shall be used for design of the platforms and stairs affected by these loads.

4. Load Combinations for Design of Headframes

4.1 *Type A — Headframes Serving Single Winder Installation Deploying Safety Detaching Hook*

4.1.1 Headframe shall be analyzed for rope breaking load in the rope(s) attached to the ascending cage/conveyance assuming that the cage/conveyance gets stuck-up; (a) in the shaft, and (b) in the headframe. In the other rope, load equal to one-third of rope breaking load shall be considered. The self-weight of the frame and other loads supported by the frame like rope guides, rigid guides, etc, shall also be taken into account.

Mine Transportation Sectional Committee, EDC 50; Shaft Equipment Subcommittee; EDC 91 : 2 (EDC 50 : 7) [Ref : Doc : EDC 91/50 (4056)]

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4.1.2 The beams supporting the bell box or bell plate shall be designed to withstand five times the load supported by the corresponding safety detaching hooks.

4.2 *Type A — Headframes Serving More than One Winder Installation Deploying Safety Detaching Hooks*

4.2.1 Headframe shall be analyzed for rope breaking load of one of the winding installation taking one-third of the rope breaking load for the second rope of same installation and working loads on the ropes of other winder installation. The worst case shall be considered. Rope breaking load shall be considered for the rope/ropes connected to the ascending cage/conveyance assuming that it gets stuck-up; (a) in the shaft, and (b) in the headframe. The self-weight of the frame and other loads supported by the frame like rope guides, rigid guides, etc, shall also be taken into account.

4.2.2 The beams supporting the bell box/bell plate shall be designed to withstand five times the load supported by the corresponding safety detaching hook.

4.3 *Type A — Headframes Serving a Single Friction Winder Installation*

4.3.1 Headframes shall be analyzed on the same lines as specified in **4.1**.

4.3.2 The buffer beams shall also be analyzed for rope breaking load.

4.3.3 The beams supporting the catches provided for holding the cage/conveyance in the event of rope failure shall be designed to withstand five times the load required to be supported by them.

4.4 *Type A — Headframes Serving More than One Friction Winder Installation*

4.4.1 Headframe shall be analyzed on the same lines as specified in **4.2**.

4.4.2 The buffer beams shall also be analyzed for rope breaking load.

4.4.3 The beams supporting the catches provided for holding the cage/conveyance in the event of rope failure shall be designed to withstand five times the load required to be supported by them.

4.5 *Type B — Headframes* — These shall be designed for the working load in the winding ropes enhanced by a multiplying factor of two. The self-weight, other supported loads and wind loads shall also be taken into account. These frames shall not be analyzed for rope breaking loads. If safety detaching hooks are used, the beams supporting bell plate/bell box shall be designed as specified for the same in **4.1.2** and **4.2.2**.

4.6 *Type C — Headframes*

4.6.1 Type C headframes shall be designed taking into account the following two conditions:

a) The suspended platform supported by the ropes passing over pulleys installed on the headframe stationary and the winding in operation — working load in the winding ropes shall be enhanced by a multiplying factor of two and only working load shall be considered in the ropes supporting the suspended platform.

b) The suspended platform in motion with winding rope stationary — In this condition, the working load in the ropes supporting the platform shall be enhanced by a multiplying factor of two while for the winding ropes only the working load shall be considered with the buckets empty as the winder in this case will not be in operation.

4.6.2 In both conditions specified in **4.6.1**, self-weight, other supported loads and wind loads shall be taken into consideration.

4.6.3 The headframes are not to be analyzed for the rope breaking situation.

4.6.4 If safety detaching hooks are used, the beams supporting bell plate/bell box shall be designed as specified in **4.1.2** and **4.2.2**.

5. Factor of Safety

5.1 Except for the exceptional cases like rope breaking and falling of cage/conveyances on the catches, the permissible stresses in the members are to be taken as specified in IS : 800-1984 'Code of practice for general construction in steel (*second revision*)'.

5.2 For the purpose of design of the beams supporting the winding sheaves and the shaft beams, if any, supporting the headframes and the corresponding rivets, bolts, pins, etc, the permissible stresses as specified in IS : 800-1984 shall be reduced by 25 percent.

5.3 The permissible stresses in the case of rope breaking and cage/conveyance falling on the catches as indicated in Table 1 shall be considered. For shop welded joints, permissible stress as specified in IS : 816-1969 'Code of practice for use of metal arc welding for general construction in mild steel (*first revision*)' shall be increased by 50 percent and for high tension pre-stressed bolted joints, stresses shall be taken as 10 percent higher than those specified in Table 1. No field welding shall be used.

TABLE 1 PERMISSIBLE STRESSES FOR LOADING DUE TO ROPE RUPTURE AND CONVEYANCE FALLING ON CATCHES

Components in Headframe	Kind of Stress	Allowance Stress MPA	Remarks
General components	Tensile, compressive* and bending	26 000	—
Pully supporting beams, columns and supporting beams at shaft mouth, if any	Tensile compressive* and bending	19 500	—
Riveted joints†	Shearing Bearing Tensile	19 500 39 000 8 000	Acting on the gross cross section of rivet
Joints with machined bolts and nuts	Shearing Bearing	19 500 39 000	Acting on the gross cross section of the rivet
	Tensile	16 000	Acting on the cross section of the base of the thread
Anchor bolts	Tensile	15 500	Acting on the cross-section at the base of the thread

Note — Allowable stresses given in the table are based on quality of steel according to IS : 226-1975 'Structural steel (standard quality) (*fifth revision*)' and any other material not inferior in quality to that specified in IS : 226-1975 may be used.

*Members under compression may be checked for buckling according to IS : 800-1984.

†For field riveting, allowable stresses may be reduced by 20 percent.

5.4 The factor of safety of the headframe against tilting shall be 1·5 considering the self-weight with and without working and wind loads, and 1·3 with loading through half the rope breaking load and self weight and other suspended loads but without wind load.

6. General Considerations

6.1 A coating of anti-corrosive paint shall be applied to headframes in accordance with IS : 800-1984 to avoid reduction in strength due to rusting.

6.2 Where the steel is directly exposed to weather and is not ordinarily accessible for cleaning and repainting, the minimum thickness of metal shall be selected in accordance with IS : 800-1984.

EXPLANATORY NOTE

In the preparation of this Indian Standard, considerable assistance has been drawn from DIN 4118-1981 'Headframes and winding towers for mines — Design loads' issued by Deutsches Instut fur Normung.

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